Boat Inspection and Cleaning Procedures For All Water Craft Owners

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Introduction [1]

These procedures have been developed to help prevent the spread of aquatic invasive species, especially quagga and zebra mussels, on trailered watercraft. Benefits to you include protecting your engine from overheating, enhanced boat performance and reduced gasoline consumption. When properly used, these procedures also preserve fishing, protect the aquatic environment, and save millions of dollars in water-supply and electric-power generating equipment maintenance. It protects water bodies from the many destructive invasive species that hitchhike on boats. Finally, it enables you to comply with state and federal laws prohibiting the spread of quagga and zebra mussels. Failure to comply in Utah could result in your boat being impounded and you could be subject to criminal prosecution (Rule R657-60). The few minutes required to inspect and clean your equipment are more than worth the many benefits.

These instructions enable you to inspect every part of your equipment that has been in contact with the water. They allow you to discover, remove, and kill, all mussels – including attached adults, juveniles and larvae. Microscopic, free-floating larvae can be found anywhere there is standing water remaining on your vessel or trailer. Attached juveniles the size of sand grains, older juveniles as large as shotgun shot, or adults up to an inch in length, might be found anywhere on your boat. Therefore, the inspection must be detailed and thorough.

When a water body is known to be affected with mussels:

- **Arriving boaters are strongly encouraged to inspect their watercraft according to these procedures before entering the water. If ANY mussel adults, juveniles or larvae are discovered, a complete decontamination of all equipment according to these procedures is required as per Rule R657-60.**
- **Boaters leaving the water are required as per Rule R657-60 to have their watercraft inspected and decontaminated (self-decontamination or professional decontamination) according to these procedures.**

When a water body is known to NOT be infected with mussels:

- **Arriving boaters are strongly encouraged to inspect their watercraft according to these procedures before entering the water. If ANY mussel adults, juveniles or larvae are discovered, a complete decontamination (self-decontamination or professional decontamination) of all equipment according to these procedures is required as per Rule R657-60.**
- Boats leaving the water are not required to be inspected and decontaminated, but such a process should become routine with every outing in which your boat is used--"Clean, Drain & Dry."

Western water bodies known to contain quagga mussels include Lake Mead, Lake Mohave, Lake Havasu, and the Colorado River Drainage below these lakes. Water bodies located in the following states and Canadian provinces are known to contain quagga and/or zebra mussels. Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New York, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, West Virginia, Wisconsin, as well as, Ontario, Canada and Quebec, Canada.[2]

General Instructions Common to All Water Craft

After boating, routinely conduct either a self-decontamination or a professional decontamination as follows:

Self-Decontamination

a.CLEAN boat of all plants, fish, mussels and mud.
b. DRAIN boat & equipment of all raw water (bilge, livewells, motor).
c. DRY boat or any equipment having touched the water--7 days summer (June, July & August); 18 days spring (March, April & May) or fall (September, October & November); and 30 days winter (December, January & February) or freeze (3 days) all properly winterized equipment.

Or

Professional Decontamination

Use a professional to apply scalding water (140°F) to wash your boat (inside and out) and trailer, and to flush your motor, bilge and livewells, including ballast tanks or anyplace else that circulates raw water.

Dispose of unused bait by emptying the bait bucket into a dumpster. Do not take bait home. Do not empty it on the ground. NEVER put left over, unwanted bait into any water body.

Drain ALL water from the boat, especially the live well. Drain all water from the bilge, motor well, (Figure 2) water-holding compartments, and water-skiing ballast tanks and bladders. See detailed instructions below for ballast tanks.

Completely drain all water from the motor cooling system. Some motors, like outboards, drain freely and easily. Other motors, like some inboards and stern-drives, can only be drained using special equipment and procedures.[3] Follow the motor manufacturer's instructions or obtain the services of a qualified service technician. This is exactly the same as draining the motor at the end of boating season to prevent freezing in the engine cooling system. Failure to do this can result in mussels growing inside the engine block and in the lines carrying cooling water to and from the motor. The consequences can be overheating, resulting in serious damage to the motor, in addition to transporting the mussels. (Figures 3, 4, & 5)

Thoroughly clean the boat, trailer and all equipment of mud, plants and mussels.
Completely remove these contaminants. In addition to looking – inspect by gently running your hand along the entire surface of the equipment. Take time and carefully feel for juvenile mussels; when you locate them, it will feel like sandpaper. (Figures 6, 7, & 8) Specifically, check the following areas.

Trailer (Figures 9 & 10)

Trailer frame	Rollers & bunks	License plate	Lights	Wiring
Axles	Springs	Fenders	Hangers	
Pockets & hollow spaces		Trailer tires & wheels		

Water Craft Exterior (Figure 1 and Figures 11, 12 & 13)

Entire hull	Trim tabs: top & bottom of hinges	Thru-hull fittings	Transducers

Pitot tube	Cavitation Plates		Ropes & Lines	Anchors
Depth sounders	Water intakes		Water outlets	Lights

Motors (Figures 3, 4, & 5)

Entire exterior housing	Propeller	Propeller shaft
Propeller shaft support	Propeller guards	Propulsion systems
Lower unit	Gimbal area	Water intakes & outlets

Boat Contents (Figure 14)

ALL nets	Float belts	Personal floatation devices	Float cushions
Rope lockers	Equipment lockers	Waterfowl decoys and camouflage blinds	
Water skis & ropes	Ski gloves	Clothing & footwear	Floats

Water weenies, torpedoes, towable tubes, inner tubes, inflatable pontoons, & similar items
Downriggers & other fishing equipment that entered the water Bait & live wells

When adult quagga or zebra mussel shells are found attached to any surface – remove and KILL THEM. (Figures 15 through 20 and Figures 35, 36, & 39) There must be neither reservation nor hesitation. These are the invasive creatures that cause so much environmental damage and cost so much money. They must be completely removed from wherever they are found – and destroyed. Adults are indicated by shells of any visible size. They are the highest risk since they are the toughest to kill and they reproduce very rapidly. There has been much research on how to kill them using chemicals, radiation, heat and other methods that are complex and difficult to implement. Therefore, simply crush them to death by stepping on them or hitting them with a rock, hammer or whatever is available. Wear eye protection, gloves and protective clothing. Dispose of the remains in a dumpster. Depending on the degree of contamination, killing all adult mussels could be a substantial amount of work. (Figures 18, 19, 20, 35, 36 & 39)

Specific Instructions Common to All Water Craft

All boats that have been in water known to be infested and
Boats and equipment where mussel juveniles have been discovered – that sandpaper feel:

(Figure 21) Completely wash with a pressurized power sprayer using water of **140^{o} F** or hotter. Contact with water at this temperature will kill quagga and zebra mussel juveniles and larvae in about 10 seconds. However, hotter water works better and a longer "cooking time" is better, too.

- Completely spray the entire exterior and interior of the craft and the trailer. Perform the wash slowly and carefully, first using low pressure scalding hot water. The idea is to "cook 'em" with heat.
- Then, re-wash using high pressure, scalding water to "remove 'em" with the pressurized water.
- Spray all small nooks and crannies where mussel larvae may be lodged.
- No soap, detergent or chemicals are necessary, however, they may be used.
- Be careful not to remove decals, paint or labels from the boat while spraying.

Using a power sprayer carwash, even one with hot water, is NOT adequate. One of the largest expenses in that business is energy to heat the water, regardless of the fuel used. Thus, there is considerable incentive to maximize profits by minimizing water heating. Some carwashes do not have any water heaters and only provide cold water washes.[4] There is no assurance that carwashes use water of at least 140^{o} F. In fact no neighborhood carwash is known to use scalding hot water. Thus, live mussel juveniles and larvae could be washed into storm drains that empty into the nearest stream.

In addition to not cleaning the boat, this would spread mussels into waterways and reservoirs. This situation indicates using carwashes to control mussels is not advised.

Equipment Cleaning

Fishing waders are a proven means of spreading invasive species. Everything from whirling disease to mud snails to quagga and zebra mussels are transported around Utah by waders. Fishermen tromp in ideal habitat and readily pick up these creatures. First, separate all individual components such as insoles, socks, booties, ankle guards, and laces. Then wash everything inside and out to remove dirt, plants and other visible substances. Be sure the treads are completely clean. Finally, soak them in a bucket or tub full of scalding hot water—you cannot get scalding hot, 140 degree F. water from your in home hot water heater. Allow sufficient soaking time for all components to reach the water temperature; thick felt soles take time. Repeat the soak with fresh scalding hot water. Another option would be to soak them in a potassium chloride solution made as described below. Completely dry all components and reassemble the waders. (Remember, it's worth it.)

Ropes, lines and cords – and – fish nets and all nets. Thoroughly wash them to remove dirt, plants and other visible substances. Then soak them in a bucket full of hot water from your house. Allow sufficient soaking time for all components to reach the water temperature. Repeat the soak with fresh scalding hot water. Another option would be to soak them in a potassium chloride solution made as described below. Completely dry them, ideally in the sun on a hot day.

Drying Kills Mussels

Mussels are tough, and it's often difficult to know what exact conditions kill them. Thus, it's beneficial to know basic concepts. High temperatures, low humidity, and prolonged time are all injurious to mussels and increase the likelihood of death. Boaters are advised to do everything possible to expose their equipment to hot and dry conditions for as long as possible. Multiple researchers have shown that dry exposure will kill all mussels.[5] In Utah DRY boat or any equipment having touched the water--7 days summer (June, July & August); 18 days spring (March, April & May) or fall (September, October & November); and 30 days winter (December, January & February) or freeze (3 days) all properly winterized equipment. Notice that these procedures contain specific actions which promote complete drying conditions. They also prevent mildew with attendant cost and health issues, and your equipment lasts longer. It's recommended to leave your boat outside in the sun, after opening and exposing compartments and wet locations.

The opposite of hot, dry conditions is found with boats that are used, and moored, in mussel-infested waters. Below the waterline it is cool and totally wet, and the boat sits for weeks, months, and sometimes years. This is ideal mussel habitat! Phytoplankton (microscopic plant food) float everywhere in the water to nourish them. Microscopic larvae attach to the hull when the boat is anchored on cruises, and when moored. Then they vigorously grow and reproduce. In a short time, they can cover the entire underside of a boat with a layer of hard-shelled creatures. This creates drag that increases gasoline consumption, can plug motor cooling systems, can damage the specialty systems described below, and generates a huge cleanup problem. Large boats that remain in mussel-infested waters for extended times are almost certain to have them. When moved to uninfested waters, they constitute the highest risk to transporting mussels. Exercise all possible diligence to inspect and clean such boats.

Boats leaving a water body known to be infected:

After inspection and cleaning according to these procedures, allow the boat and trailer to air-dry as follows: DRY boat or any equipment having touched the water--7 days summer (June, July & August); 18 days spring (March, April & May) or fall (September, October & November); and 30 days winter (December, January & February) or freeze (3 days) all properly winterized equipment.[6] **Longer is better.**

Boats arriving at a water body known to NOT be infected:
Preferably, the boat and equipment have already been cleaned, drained and dried. Personnel at the location will confirm the boat's history. If justified by inspection, the boat will be required to undergo decontamination.

Additional Instructions for Specialty Systems on Selected Water Craft

Internal ballast tank systems in water ski boats are one of the greatest risks for transporting mussel larvae and juveniles. It is believed that ballast systems in ocean-going ships and anchor chains first brought quagga and zebra mussels to the Great Lakes in 1988. Clearly, ballast systems transport invasive species.

Drain ballast water from every tank as much as possible. Then add mussel-killing potassium chloride, reaching a solution of 100 ppm to each tank and allow it to remain there for about 48 hours. Install the solution immediately upon leaving mussel-infested waters and allow the solution to act while traveling to the next destination. Upon arriving, simply resume your normal ballast system operation; the tanks do not have to be drained. This is exactly the same as putting anti-freeze in the system at the end of the boating season. Follow the boat manufacturer's instructions or obtain the services of a qualified service technician. Be sure to install antifreeze in the system at the end of the boating season. (Figures 22 through 27)

Failure to do this will definitely result in mussels growing inside the entire system. The consequences will be restriction of water lines, overheating, and damage to the pumps. Complete replacement of system components, possibly even the tanks, will become necessary and this is costly.

There are also portable, collapsible ballast tank systems retrofitted on boats which do not have internal systems built in at the factory. These systems should also have the water drained and then have mussel-killing potassium chloride solution added and operated as described above. Otherwise, they too will grow mussels inside with the same consequences.

An effective mussel-killing solution – for each ballast tank – is two gallons of a 200 parts per million (ppm) solution of potassium chloride (KCL). Despite the fact that it will kill mussels, this solution is harmless to humans and to the environment.[7] It also has extremely low corrosion characteristics and has been used in the oil well drilling industry for decades due to these characteristics.[8] A chloride concentration of 250 ppm is allowable for drinking water[9] and the solution is below that level. Potassium chloride salt crystals are used in water softener systems; people drink and bath in such water.[10] Conservative estimates of potassium and chloride concentration in Lake Powell with usage as indicated above, indicate concentrations of 1 part per trillion. That is far below possible environmental harm.[11] In fact, KCL solution was used in Virginia to completely kill all zebra mussels in a quarry. "In dramatic contrast, other aquatic wildlife including turtles, fishes, aquatic insects, and snails continue to thrive in the quarry."[12]

Potassium chloride (KCL) solutions in concentrations of 200 ppm can be made by thoroughly mixing one teaspoon of dry KCL salt crystals in two gallons of water. KCL salt crystals are available at stores such as Home Depot and water softener suppliers. Morton Salt Company offers KCL in 40-pound bags.[13] Do NOT use any other kind of salt or solution. Potassium chloride premixed solutions are available from suppliers to the oil well drilling industry; a Salt Lake City dealer has indicated willingness to do so.[14] KCL is mined in Moab and is also available in the Uintah Basin. The solution can be provided in larger quantities, such as drums, that may be suitable for marinas and others providing boat maintenance services.

Large boats, houseboats for example, may have special systems that use lake water. These systems require additional effort to protect them from plugging. Located deep inside the hull, these systems are especially difficult to access to clean should they become mussel infested. Complete replacement of system components may become necessary and this is costly. This is a prime example of, "an ounce of prevention is worth a pound of cure." The entire system should be completely drained and dried immediately upon leaving the water. The longer boats are left in infested waters, the more likely these systems will become plugged. The entire system includes water supply and discharge lines, filter screens, pumps, valves, and associated components. Special systems that use lake water include:

- **Air conditioning systems.** Liquid coolant in the air conditioner system removes heat from living quarters. That liquid coolant then transfers the heat (through a radiator) to lake water that is circulated through the radiator. Small passages in the radiator core are highly susceptible to plugging by mussels.
- **Personal sanitation systems** that take lake water and use if for bath showers and other "gray water" uses.
- **Washdown systems** that pump water into hoses for boat cleaning, water slides and general use.

(Figures 29 through 34 and Figures 37, 38, & 39)

Sailboat Additional Instructions (Figure 36)

Inspect and clean all of the above that apply, in addition to the following.

Centerboard box **(a major concern)** Rudder and transom Keel Fittings

Personal Watercraft Additional Instructions[15] (Figures 40, 41, & 42)

- Do not run your craft through aquatic plants. This could damage the craft, plug water intakes, and increase mussel contamination.
- After finishing activities, push or winch your craft onto the trailer without running the engine.
- Secure the craft to the trailer and remove it from the water.
- Start and run the motor for five to ten seconds to blow out water and contaminants from the underbody jet drive system.
- Stop the engine and remove all plants, mud, and other contaminants from the steering nozzle.
- Look under the craft and remove all contaminants. Especially check the water intake area, including the edges of the intake grate.
- Dry pockets that may be wet or holding water.
- Inspect and clean the craft and trailer as described previously.

Diving Gear Additional Instructions

Diving gear is a proven means of spreading invasive species, including quagga and zebra mussels. Divers swim in ideal mussel habitat and easily pick up larvae and juveniles. Thoroughly wash everything inside and out to remove dirt, plants and other visible substances. This includes masks, wetsuits, booties and gloves. Also wash air tanks, air lines, regulators, and flippers. Finally, soak all equipment in a bucket or bathtub full of hot water from your house. Allow sufficient soaking time for all components to reach the water temperature. Repeat the soak with fresh hot water. Completely dry all equipment, ideally in sunlight. (Remember, it's worth it.)

Dive shops might consider providing dip tanks filled with safe mussel-killing solutions. See the description above, "**Internal ballast tank systems in water ski boats**." Individual divers might also use such solutions instead of hot water.

Kayaks, Canoes, and Inflatable Rafts Additional Instructions

Inspect and clean as described previously. Allow to dry thoroughly before using them in any other water body. Be especially careful to dry inflatables before rolling them up.

Additional Information

Chlorine may be used to kill mussels, but only under carefully controlled circumstances.

- Chlorine is toxic, corrosive, and a strong oxidizer; it is extremely reactive.[16] Only properly trained personnel, wearing protective equipment, should use chlorine. Work must be done in specifically designated areas and every one else should be kept out.
- Chlorine can be detrimental to the environment and harmful to water bodies in sufficient concentrations. Control chlorine runoff through evaporation or proper disposal.
- Chlorine solution in 6 % concentration with 30 minutes exposure has been used for years to kill mussels. Read the container label to confirm it, but bleach obtained from a grocery store is often this concentration straight from the bottle. Industrial chemical suppliers provide higher concentrations that would have to be diluted to achieve 6% concentration. Treatment should be conducted only as long as necessary to prevent damage to whatever boat system is being treated. Thoroughly rinse with clear water the areas where chlorine has been used.

People and Pets: Although the risk is low, people and pets can possibly transport larvae, particularly on swimwear or beach shoes. It's a good idea to clean personal belongings and clothes that have been in contact with the water. It's also a good idea to wash dogs and other pets that have been in the water. Brush their coats and dry them.

Thank you for doing your part to keep our waters clean, healthy and enjoyable!!

It takes some effort to prevent the spread of quagga and zebra mussels, and everyone benefits – including you. Please visit the Internet websites cited below for more information.

A separate pdf document containing only the referenced figures accompanies this document.

The title is, "Pictures to Accompany Boat Inspection & Cleaning Procedures." Both documents are for the following audiences.

USER	INTENT
ALL Boat Owners: ALL boat sizes	Care for your equipment, the waters you enjoy, and our industries.
State Wildlife Officers	Protect aquatic resources & industry through law enforcement.
State & National Park Rangers	Protect aquatic resources & industry through law enforcement.
State Highway Patrol Officers	Protect aquatic resources & industry through law enforcement.
State Port of Entry Inspectors	Protect aquatic resources & industry through law enforcement.
State Park & National Park boat inspectors at park entrances and boat ramps	Protect aquatic resources & industry through law enforcement.
State & National employees in all aspects of aquatic resource management	Protect aquatic resources & industry through law enforcement.
State Park & National Park concessionaires	Instructions to achieve compliance & assist customer understanding.
Boat Dealerships: new & used ALL types of boats	Help customers understand mussel situation & comply with requirements.
Commercial boat transportation companies	Help customers understand mussel situation & comply with requirements.
SCUBA Dive Shops & divers	Help customers understand mussel situation & comply with requirements.
Numerous Internet websites	Distribute information to numerous audiences.
Television, radio, newspapers & magazines	Distribute information to numerous audiences.

This document was created in response to numerous inquiries about how to implement general boat inspection and cleaning instructions. It is the result of joint efforts by personnel from the following:

- Utah Division of Wildlife Resources
- Utah Division of Water Resources
- Utah State Parks and Recreation
- Utah Division of Water Quality
- Utah Division of Drinking Water
- National Park Service, Glen Canyon National Recreation Area
- New York State Sea Grant National Aquatic Nuisance Species Clearinghouse
- Pacific States Marine Fisheries Commission
- Volunteer at Lake Mead House Boat Association
- Several boat dealers in the Salt Lake City area
- Mercury Marine Co. and Yamaha Motor, Marine Division

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[1] Several sources contributed to the content of these instructions. Prominent among them are:

- **Mr. Chuck O'Neill**, Director of the Sea Grant National Aquatic Nuisance Species Clearinghouse, www.aquaticinvaders.org/ (585) 395-5190, email: cro4@cornell.edu
- www.100thmeridian.org/video/clean.asp *Stop Exotics, Clean Your Boat Video*, March 13, 2007.
- www.protectyourwaters.org/ March 13, 2007.

In addition, numerous reviewers have provided valuable insight and additional data. Thank you.

[2] *It Only Takes One, The Battle to Prevent the Spread of Zebra Mussels on Trailered Watercraft*, Pacific States Marine Fisheries Commission, DVD video and Watercraft Inspection Training Guide, 2006, page 13. Arizona, California, and Nevada were added after discovery of quagga mussels in those states in January 2007.

[3] Based on phone conversations with technical personnel at Mercury Marine Co. (920) 929-5884, and Yamaha Motor, Marine Division, (770) 420-5868, March 16, 2007.

[4] www.carwash.com/article.asp?IndexID=6636655 March 17, 2007.

[5] **Mr. Chuck O'Neill**, Director of the Sea Grant National Aquatic Nuisance Species Clearinghouse, www.aquaticinvaders.org/ (585) 395-5190, email: cro4@cornell.edu March 21, 2007.

[6] www.protectyourwaters.org/prevention/prevention_generic.php#1 March 21, 2007

[7] www.dgif.state.va.us/zebramussels/ March 26, 2007.

[8] http://www.bjservices.com/website/Completions.nsf/0/6DE175AADF573F5186256F2A0065674C/$file/Potassium+Chloride-99+Percent.pdf March 26, 2007.

[9] www.rules.utah.gov/publicat/code/r309/r309-200.htm#T6 "The Secondary Maximum Contaminant Levels for public water systems deals with substances which affect the aesthetic quality of drinking water. They are presented here as recommended limits or ranges and are not grounds for rejection. The taste of water may be unpleasant and the usefulness of the water may be impaired if these standards are significantly exceeded."

[10] www.mortonsalt.com/faq/faq_wate.asp?id=19 March 26, 2007.

[11] Investigation conducted by the Utah Division of Water Resources, March 26, 2007. The investigation was verified by the Utah Division of Water Quality as being environmentally safe and by the Utah Division of Drinking Water as being safe for humans.

[12] www.dgif.state.va.us/zebramussels/ March 26, 2007.

[13] www.mortonsalt.com/consumer/products/watersoftening/pc_pellets.htm March 26, 2007.

[14] Intermountain Drilling Supply, 3412 West 2400 South, West Valley City, UT, (801) 972-6455.

[15] www.100thmeridian.org/video/clean.asp *Stop Exotics, Clean Your Boat Video*, March 13, 2007.

[16] www.westlakechemical.com/datasheets/MSDS_Chlorine.pdf March 19, 2007.